Cut or Wait Decision-Making for Landowners

Determining payment amounts necessary for postponing harvest for a year

MISSISSIPPI STATE UNIVERSITY EXTENSION

As a forest landowner, one of the most important questions you must answer is when to conduct a harvest. How you make that decision can involve several factors specific to your circumstances and objectives. One decision criterion is to conduct the harvest at a time that maximizes financial return of your forested property. A forest management plan will indicate when and how much to harvest in the future.

Typically, landowners don’t have a set year in mind to harvest; instead, they have a window of years. This timeframe can be influenced by many factors (e.g., drought that slowed growth for several years, price changes, individual preferences, capital gains tax changes), and landowners should know the advantages and disadvantages to postponing their harvest. This decision is often affected by expected or realized price fluctuations.

Beyond purely financial reasons, many landowners enjoy the benefits provided by a forest and may want to postpone a harvest to enjoy the mature forest for an additional year. Forests provide habitat for wildlife such as migratory birds and game species like deer and turkey. They also provide ecosystem services like carbon storage and water filtration. Some of these benefits can generate income for landowners, such as hunting leases or a potential future carbon market.

Think of the following exercise as providing guidance on what ***minimum*** price (or payment) you would need to justify delaying revenue from a harvest for one additional year for any of the reasons described above.

We start our analysis looking at an important concept in economics. What economists call “marginal analysis” allows us to consider the costs and benefits of doing just one more or one less of some activity (e.g., the effect of an additional pound of fertilizer on crop productivity, or the effect of an additional hunting group in the deer population).

For this exercise, we are concerned with the financial **benefits** and **costs** of postponing a harvest to allow a stand of trees to grow for one year (or the economic effect of an additional year without harvesting). This is only an example, and results will vary for each property. However, it gives an idea of the many factors involved in a “simple” decision.

Benefits

What are the benefits and costs associated with growing your forest for another year? The primary benefit is that trees will continue to grow, adding volume and, therefore, value that will be harvested, in this case a year later. To determine the value of additional growth over that year, simply multiply the stumpage price of your timber yield by the volume growth (annual increments).

The marginal benefit of postponing a harvest for an additional year is:

$$MB_R = \text{Price} \times \text{Annual Increment}_{R+1}$$

Here, MB is marginal benefit and the subscript R is the rotation age of the forest when the calculation is being made. The subscript R+1 is the subsequent year. Annual increment is the growth of all the merchandisable products from the years R to R+1.

Costs

The downside to growing trees for an additional year is the costs. Most forest landowners have property taxes, management fees, and perhaps interest on the property (carrying charges) that need to be accounted for as they have to be paid for the additional year. While those are clear, other costs are not. There is the cost of using the land for one more year; here, we assume it is the cost of delaying the start of the next rotation. This is an opportunity cost, or the value of what you lose when choosing between two or more options.

How should you value an even-aged plantation or forest investment in general? To answer this question, think of land as a financial asset. If you borrow a financial asset, how much do you pay for its use? You pay interest to use financial assets, which is calculated by multiplying the value of the asset times the interest rate. The value of a forest property is its highest land expectation value (LEV), which represents the bare land value of the forest stand that the landowner would pay if they harvested at the financially optimal rotation age.

The opportunity cost of using land for one year should be the discount rate (returns from investing in financial assets elsewhere; we'll call this rate "r") multiplied by the optimal LEV. This r represents the real rate of interest. A real discount rate—as opposed to a nominal discount rate, which is what people usually think of when they think about interest rates—is an inflation-adjusted return. The individual rate is specific to the individual landowner, but a "typical" rate as of 2021 is around 4–5 percent.

The marginal cost of postponing a harvest for an additional year is:

$$MC_R = \text{Annual Costs} + (LEV_R \times r) + (\text{Price} \times \text{Yield} \times r)$$

MC is marginal cost, and the subscript R is the age of the forest when the calculation is being made. The marginal net benefit is, therefore, $\mathbf{NB_R = MB_R - MC_R}$. If the result is a positive number, postponing harvest for one year is financially attractive; if it's negative, landowners should consider harvesting.

This analysis can be used by landowners to determine a payment that would be necessary to postpone a harvest if an interested buyer were available, or to place a price on enjoying the land for nonharvest reasons for an additional year (i.e., a value high enough that makes the net benefit positive or at least zero). Most typically, though, it would be used to determine what price increases for stumpage are necessary to postpone for a year beyond financial maturity.

Example

Before we dive into the example, please remember that each property will have different costs, revenues, and forest structure. We focus on pine plantations because they are important in the Southeast and because financial returns are a primary objective of many pine plantation owners. The above formulas help answer our major question in this case: How much money would it take for me to be just as well off financially, if I postpone my harvest one year versus cutting the trees today?

Using a common simulator for pine plantation growth and yield, we estimated the optimal rotation age for several combinations of thinning and final harvest schedules to cover common strategies used by forest landowners. We will refer to them as treatments from here forward (Table 1). We also provide thinning outcomes (in green tons) from these treatments, or prescriptions, for the three products typically grown in a pine plantation forest (Table 2). The final harvest age is determined using the year in which LEV is highest for each treatment. We then calculate the marginal cost if the forest is held for another year.

Other underlying assumptions that are consistent across all four treatments include timber volume, prices, costs of establishment, annual costs, and the discount rate (r from the marginal cost formula above). These assumptions are outlined in Table 3 and discussed in more detail below.

Table 1. Harvest timing schedules.

Treatment	Schedule
Treatment 1	No thinning; final harvest at 28 years old
Treatment 2	Thin at 18; final harvest at 37 years old
Treatment 3	Thin at 14; final harvest at 35 years old
Treatment 4	Thin at 14 and 20; final harvest at 36 years old

Source: *PTAEDA4.0: Simulation of individual tree growth, stand development, and economic evaluation in loblolly pine plantations.* Virginia Tech University.

Table 2. Volume harvested per treatment (green tons).

Treatment 1

Schedule	Pulpwood	CNS	Sawtimber
Final harvest at 28 years old	39.20	71.30	1.40
Postponed final harvest at 29 years old	39.80	74.40	2.00

Treatment 2

Schedule	Pulpwood	CNS	Sawtimber
Thin at 18	30.70	1.80	–
Final harvest at 37 years old	27.70	21.00	59.90
Postponed final harvest at 38 years old	29.70	17.00	70.10

Treatment 3

Schedule	Pulpwood	CNS	Sawtimber
Thin at 14	14.10	–	–
Final harvest at 35 years old	32.00	44.80	50.00
Postponed final harvest at 36 years old	33.30	42.90	53.70

Treatment 4

Schedule	Pulpwood	CNS	Sawtimber
Thin at 14	14.10	–	–
Thin at 20	17.90	11.40	–
Final harvest at 36 years old	26.50	3.10	66.50
Postponed final harvest at 37 years old	27.50	2.60	70.20

Note: Yield curves for a pine plantation with initial spacing of 606 trees per acres, site index at 25 of 60, and basal area reduced to 60 square feet in every thinning.

Table 3. Forest management assumptions.

Source of Revenues

Variable	Value	Unit
Pulpwood	5	$ per ton
CNS	15	$ per ton
Sawtimber	22	$ per ton

Source of Costs

Variable	Value	Unit
Annual costs	6.00	$ per acre
Chemical treatment	76.65	$ per acre
Planting (606)	62.79	$ per acre
Seedlings (0.09 per)	54.54	$ per acre
Burning	29.94	$ per acre
Total establishment costs	**223.92**	**$ per acre**

Other Management Factors

Variable	Value	Unit
Discount rate	4, 4.5, 5	%
Trees (8′ × 9′ spacing)	606	Trees per acre

Note: All costs were taken from Maggard, A., & Barlow, R. (2019). 2017 cost and cost trends for forestry practices in the south. *Forest Landowner, 72*(4):23–31. Prices were gathered from various issues of Timber Mart South Price Reports and the Mississippi Timber Price Report for the last two years. These amounts are not reflective of a particular property and should not be assumed to apply to your forest specifically.

The discount rate represents the best alternative investment return you could get if you did not invest your money in the forest. While there is variation among landowner types and individuals, based on conversations with market analysts, 4–5 percent is common. Keep in mind that the rate directly impacts your final harvest date. A higher rate leads to an earlier final harvest, while a lower rate extends the final harvest further into the future. For the four treatments listed in Table 1, the timeline moves up 1 to 3 years depending on the treatment chosen.

Now that we have all our inputs, we can generate our necessary "payment" to forego harvest.

Results

Using the 4 percent discount rate (Table 4), we see that, for treatment 1, to postpone harvest from 28 years to 29 years would require $4.40 per acre per year, or 0.4 cents per ton per year. As you can see, the results vary significantly across treatment types. For treatment 3, the cost of postponing harvest jumps to over $35 per acre per year. This is a result of forest management practices and the corresponding financial outcomes.

The added "growth" from the final harvest age to the next year is similar for treatments 3 and 4 (see Table 2). Despite this, the difference between marginal benefit and marginal cost at the optimal rotation age is $20 higher for treatment 4, making it less costly to delay harvest. However, treatment 4 would still be preferred to treatment 3 using standard financial criterion (the LEV criterion mentioned earlier). In other words, just because a treatment fetches a higher "payment" does not make it the optimal treatment type.

Also note that the further you get away from your optimal harvest year, the larger the payment must be to break even between harvesting now or waiting. See Table 3 for the full list of prices for the treatments and site index (SI = 60 at 25 years).

We also examine the effects of increasing the discount rate by one half and 1 percent to determine how changing the discount rate alters payments per acre and per ton. Typically, one would expect the price to rise since the landowner has a higher opportunity cost for letting trees grow an additional year. However, you must remember that, as the discount rate increases, many other factors also change, including the optimal harvest age, which occurs sooner.

In other words, when using these equations, it is hard to make general assumptions about how changes will affect prices. Year-to-year changes in growth and yields and changes in product class (volumes moving from pulpwood to CNS to sawtimber) within the PTEADA model do not occur smoothly, so the MB/MC relationship isn't as straightforward as you might expect.

Table 4. Treatment types for loblolly pine plantation and corresponding prices for postponing harvest for three different discount rates. Site index = 60.

Treatment Type	4% discount rate		4.5% discount rate		5% discount rate	
	price (per acre)	price (per ton)	price (per acre)	price (per ton)	price (per acre)	price (per ton)
Treatment 1 (28 to 29 years old)	4.40	0.04	7.81	0.07	10.26	0.10
Treatment 2 (37 to 38 years old)	20.18	0.17	12.09	0.11	4.67	0.04
Treatment 3 (36 to 37 years old)	35.63	0.28	42.22	0.33	48.96	0.39
Treatment 4 (35 to 36 years old)	4.53	0.05	3.19	0.03	8.07	0.09

Carbon Sequestration

Concerns regarding climate change continue to push innovations to limit heat-trapping gases such as carbon dioxide (CO_2) from our atmosphere. Trees absorb CO_2 and sequester, or store, the carbon in their tissues. The trapped carbon is the primary component of the tree's wood volume. A general calculation is that each pound of bone-dry wood, where all water has been removed, is approximately 50 percent carbon by weight. For example, a 1,000-pound block of wood that contained no water would be estimated to contain 500 pounds of carbon alone. As a result, trees have tremendous potential to mitigate climate change.

If many forest landowners agreed to grow their timber stands a year or two longer before harvesting them, then the timber inventory would contain greater carbon stores. Programs are currently being tested to see if this can be done by paying forest landowners to postpone harvesting for a year or two.

Investigation into what prices landowners are willing to accept for storing carbon vary considerably across study areas. In Vermont, the necessary payment ranged from $5 to $15 per acre per year, but in South Carolina the price was closer to $60 per acre per year. Other studies found prices ranging between these two cases. These prices are in line with our results in Table 4.

These studies also suggest that landowners tend to prefer short-term contracts, but not always. New activity in carbon markets is focused on designing markets that are short-term agreements between sellers (forest landowners) and buyers. These agreements amount to a short-term rental of forest stands for the purpose of carbon sequestration.

Conclusions

Under certain conditions, a forest landowner may be willing to forgo a harvest. Naturally, they want to know how much they should receive in terms of compensation. This analysis provides landowners with a framework to decide what that compensation should look like but is merely a first attempt at providing insight on this complex topic.

With a novel approach, this publication explores how a forest landowner could approach factoring in forgoing a final harvest for one year as an **additional** forest management and investment goal. However, use caution in applying these results. This analysis attempts to approximate a "typical" forest management regime in pine plantation forests in the southeast United States. Any price increases (or payments) depend on the circumstances particular to your forest property, market conditions, and location. The formulas used are sensitive to treatment type and discount rate selected, and the results are specific to assumptions we imposed. There are many alternative treatments that could affect the price point.

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